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ABSTRACT

The exact nature of the events which may predispose a person to substance abuse is not known. This paper provides a theoretical discussion and review which emphasizes three contexts which have been shown to predispose on individual to drug abuse: (1) prenatal exposure to a given substance; (2) environmental conditions present upon first exposure to an abuseable substance; and (3) the environment in which a person lives and functions. Support for each of these factors in combination as probable causal factors in substance abuse is garnered from both human and nonhuman investigations. Research findings are discussed concerning such factors as Fetal Alcohol Syndrome, the social context in which people are first exposed to the use of drugs and alcohol, contextual reihforcers and constraints, and excessive drug abuse as adjunctive to schedule-induced behavior. Drug abuse is therefore considered as an interaction between both environmental and physiological variables. The paper concludes by calling for multi-generation testing to evaluate the role of genetic influences in predisposing drug abuse. References are included. (Author/TE)

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Factors Predisposing Drug Abuse

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Abstract

The exact nature of what events may predispose a person to substance abuse is not known. A theoretical discussion and review is presented here emphasizing prenatal exposure to a given substance, environmental conditions present upon first exposure to an abuseable substance, and finally the environment in which a person lives and functions. Support for each of these factors in combination as being probable causal factors in substance abuse is garnered from both human and non-human investigations.

It is not clear why some individuals will overuse a given drug after initial exposure while others can maintain controlled continued use, or even abstain totally. Investigation into the organismic and environmental factors that contribute to substance abuse is a source of increased attention as more resources are put to fighting the war on drugs.

It is clear that human drug abuse behavior represents a very complex interaction between environmental and organismic variables, both prenatal and postnatal, and that the determination of predisposing factors requires complex experimental analysis.

In this paper we emphasize three contexts wherein the predisposition of an individual to abuse drugs may be established. We review experimental literature from both human and nonhuman research in order to emphasize the need for examination of variables in all three conditions. The three factors we consider critical are, prenatal exposure, the context of a first postnatal "voluntary" exposure, and the maintenance environment of the adult organism.

One inadequately considered factor emerging from the literature with nonhuman subjects is that intrauterine exposure to specific chemical agents or dietary factors can significantly alter the subsequent intake preferences and consumption patterns of such agents in mature animals (Borges & Lewis, 1981; Molina et al., 1987; Phillips & Stainbrook, 1976; Provenza, Pfister, & Cheney, 1990; Randall et al., 1983). For example, Molina et al, treated pregnant rats with a single injection of ethanol on day 8 of gestation and when the pups were tested at age 60 days the treatment animals drank significantly more ethanol than controls.

Such acute intrauterine exposure has also been shown to alter normal patterns of behavioral development so as to contribute to aberrant responsiveness to a given pharmaceutical or dietary agent. That is, one-time

in-utero exposure to a substance has been shown to produce aberrant rat emotional reactivity, locomotor activity, and learning abilities such as prolonged response perseveration, or retarded acquisition of avoidance responses (Molina et al. 1984, Revkin, 1989, Wigal & Amsel, 1990).

In humans, it is well established that maternal consumption of alcohol during pregnancy, even as limited as one bout of drinking, can produce Fetal Alcohol Syndrome. This condition is characterized as producing low birth weight, mild to moderate mental retardation and often some facial morphological abnormalities. Hyperactivity, irritability and tremulousness are also commonly seen in the offspring of alcohol exposed mothers (Carlsen, 1988). Other somewhat similar behavior and physiological patterns have been found after "heavy" use of marijuana, (Hingson, et al., 1982) and with cocaine and crack exposure (Revkin, 1989). Having been first characterized in 1968 (Grilley, 1989), Fetal Alcohol Syndrome has a well documented clinical outcome, but because of its relatively short history, longitudinal studies can only now begin to report outcomes in terms of long-term effects on behavior and development in FAS adults. As far as we know, there are no reports of adult FAS individuals and their alcohol or drug abuse behavior patterns, however, a conclusion linking the two is supported by the nonhuman data. One can conclude that in-utero exposure is an environmental manipulation with organismic results that can contribute to the predisposition for substance abuse. Such contextural treatment has not, until recently, been seriously or extensively researched.

A second condition which needs more evaluation as a predisposing factor has to do with the contributions of the environmental conditions present when a maturing animal experiences it's <u>first postnatal exposure</u> to a pharmaceutical agent (Molina, et al, 1985; Molina, Hoffman & Spear, 1986;

Molina, Serwatka, & Spear, 1986; Molina & Chotro, 1989; Serwatka, Molina, & Spear, 1986).

The excessive consumption of drugs has been found to be profoundly affected by early ontogenetic experiences with a substance that may alter physiology. For example, it has been observed in animals that ethanol intoxication during those postnatal periods characterized by extensive growth in the central nervous system can lead to increased adult ethanol consumption (Hayashi & Tadokoro, 1985). This increase in adult consumption following early exposure does not simply reflect an increase in tolerance (Molina & Chotro, 1989). Instead, it is suggested that young animals are conditioned to sensory cues associated with ethanol and that after subsequent exposure to these cues, the animals show an increase in ethanol consumption. Early experiences involving the odor or taste of ethanol paired with different reinforcers will affect both immediate and later responses toward these sensory cues (Molina et al., 1987).

It is conventional wisdom that the social context in which a person first uses marijuana, alcohol, or heroin, is critical in terms of repeated use of the substance. That is, in most cases the first use of a drug is either physiologically unpleasant, or neutral at best, and only the presence of reinforcing peers will maintain the subjects' consumption of the drug. Often juveniles will mask the flavor of alcohol with sweet liquids, overindulge and get sick. However, using alcohol often continues hidden within a new flavor. Taste aversion occurs, while peer pressure remains, so masking flavors are changed.

Similar effects may occur with other drugs and the consequating event that maintains the behavior is not the drug but is an external, and usually

social, conditioned reinforcer. Clearly this context at first exposure is an important issue in considering predisposing factors to substance abuse.

Furthermore, among humans in the absence of social reinforcement, if drug effects are paired with novel flavors and gastrointestinal malaise the substance will be avoided in the future. Alternatively, if reinforcing events surround the ingestion of a novel substance its hedonic value may be enhanced leading to further consumption. Such research indicates that the abuse potential of a given drug can vary as a direct function of the presence of other reinforcers or as a result of an altered physiology. Conversely, the reinforcing value of the same drug can also vary as an inverse function of the presence of punishers that become associated with the drugs' effects. Various studies provide support for both outcomes.

Such data indicates that environmental conditions present at first use can have an impact on future substance use. In addition, Hayashi and Tadokoro's data (1985) indicate that at the very least an interaction exists between organismic variables and environmental context in terms of future abusive behavior. This is a point we wish to stress in this paper, <u>both</u> sources of potential influence, the environment and the neurological, need to be considered and treated as major sources of predisposing factors.

The early exposure literature contains few studies using human subjects. For one reason, alcohol or heavy drug use is not frequent until adolescence among humans (Chassin, Mann, & Sher, 1988), at least in the predominant culture in the United States; therefore, initial experiences with such substances are no doubt much less common among juveniles. It is the case that smoking occurs at earlier ages and has been shown to correlate with less hesitancy to intake, greater risk taking and drug experimentation, and cigarettes are often more accessible than alcohol or other drugs of abuse

(Fleming et al., 1989). While reinforcing and or punishing conditions present when a person first experiences a given drug substance can be seen as an influencing factor in subsequent use, their exact contribution has not been precisely determined and could possibly be overridden by response consequences present upon future occasions of use. This brings us to the third condition, which is an essential contributing factor to the maintenance of substance abuse.

A large body of literature indicates that substance abuse can be a function of availability within a context of other reinforcers and access constraints (Carroll & Meisch, 1984; Vucinich, 1982, Vuchinich & Tucker, 1988). For example, Carroll and Meisch (1984) reviewed research showing that food deprivation radically shifted an animal's behavior towards increased intake of available drugs. This shift was not a simple adjustment to other nutritive or caloric sources, as food deprivation was found to increase responding maintained by drugs that did not contain calories. Instead, it is suggested that changes in feeding conditions may alter the reinforcing efficacy of various drugs, as the effect is less pronounced with drugs that are not easily established as reinforcers (Carroll & Meisch, 1984).

Human studies involving food deprivation are understandably scarce; however, there is evidence for increased consumption of coffee and tobacco by men participating in a World War II semi-starvation study (Franklin, Schiele, Brozek, & Keys, 1948), and for increased coca leaf chewing following food deprivation among Indians of the high plateaus of Peru (Hanna & Hornick, 1977). The point is that simple manipulations in nutrient availability can influence drug consumption.

Vucinich and Tucker (1988) review research demonstrating that preference for alcohol or other drugs varies inversely as a function of direct

constraints on access to the drug, whether availability is altered through a response requirement, response cost, or other restrictions on availability. These manipulations have been shown to affect the alcohol consumption of both human alcoholics and nonalcoholics. Such reports are also supported by abundant non-human data. For example, Griffiths et al., 1980, concluded that a clear relationship could be seen across species, across drug substances, and across contexts, such that as response requirement contingencies for drug delivery increased, the amount of drug self-administration decreased. Meisch and Thompson (1973) demonstrated that rats' ethanol consumption varied inversely as a function of the fixed-ratio requirement in effect for access to the ethanol. Further, Poling and Thompson (1977a, 1977b, 1977c) found that ethanol self-administration by rats decreased if it was followed by contingent electric shock or by increasing delays to food delivery.

Griffiths, Bigelow, and Liebson (1978) showed that ethanol consumption by human alcoholics could be substantially reduced if timeout from social activities or other reinforcers was made contingent upon consumption. In addition, Bigelow and Liebson (1972) demonstrated that varying the cost of drinking on fixed ratio schedules of reinforcement reduced drinking by alcoholics to zero or near zero levels of consumption. Interestingly enough, while interval schedules of reinforcement could be a more realistic simulation of the response requirements for alcohol delivery in the environment, the use of interval schedules for drug delivery has not been examined to our knowledge. Although restricting access can be shown to have a powerful effect on drinking alcohol, it may be that the availability of other reinforcers, and any constraints on them, are more important in the natural environments of individuals prone to abuse (Vuchinich & Tucker, 1988). In further support of this, Aasland (1989) has shown, on a national level, the effects of cost and

constraints upon access to alcohol in the context of other reinforcers. For the years 1960-1982 in Norway, a clear relation can be seen in that as the price wage index in Norway declined, alcohol consumption steadily increased.

While excessive drug intake has at times been described as voluntary or elective, at least in the early stages, the conceptualization of drug abuse as adjunctive behavior might also represent a useful way of describing the possible effects of one's environment on drug abuse (Epling & Pierce, 1983). Adjunctive behavior is defined as behavior that is induced as a function of the scheduling of reinforcers for other behavior (Falk, 1972). While there are some clear differences between schedule-induced behavior in animals and in humans, Riley and Wetherington (1989) recently concluded that there are also many similarities between schedule-induced polydipsia in animals and schedule-induced behaviors in humans, in terms of excessiveness and associated compulsive behavior patterns. For example, Cherek (1982) examined the effects of following button pressing with money across different fixed interval schedules of reinforcement, ranging from FI30 to FI240. Besides button pressing, data on smoking was collected in terms of number of cigarettes smoked, puffs per cigarette, puffs per hour and puff duration. Variations in the inter-reinforcement interval (IRI) did not effect number of cigarettes or puff duration, however, the number of puffs per hour and the number of puffs per cigarette were affected. Specifically, puffs per hour and the number of puffs per cigarette showed an inverted U-shaped curve as a function of increases in the IRI. These two variables were at their maximum under an FI120 schedule, with lower rates at intervals shorter and longer than the FI120. Also, the number of puffs per cigarette was found to be highest in the first third of the IRI, which is the period most typically associated with higher rates of schedule-induced polydipsia (Shurtleff et al. 1983; Staddon,

1977). This pattern of variation in schedule-induced behavior with increases in the IRI is a typical finding in such studies (Falk, 1966, 1972; Riley et al. 1985; Wetherington, 1979). These and other reports (Cantor, 1981; Cantor, Smith, & Bryan, 1982; Cantor & Wilson, 1984) suggest the conclusion that some aspects of drug consumption or abuse patterns, such as it's excessive nature and high strength, might be explained in terms of adjunctive behavior.

While such variables may not encompass all the factors that might predispose to drug abuse, we suggest that drug abuse must be considered as an interaction between a number of variables, involving both the environment and the physiology of the organism. It is not a simple problem, and solutions will not be simple.

In conclusion, a model testing procedure that we feel adequately evaluates predisposing factors must involve perhaps multi-generation testing to evaluate genetic influences. Researchers have genetically selected rats which show alcohol-preferring behavior (Lumenz, Hawkins, & Li, 1977; Morzaratti et al., 1988). This behavior could certainly be produced and enhanced through natural selection, as a result, genetic influences on behavior must not be overlooked. Also, extensive first experience conditions need to be examined at a variety of ages to determine social and neurological variables. Finally, a maintenance environment approximating the complexities of a multi-choice and response cost situation needs to be simulated. The evidence presently implicates both traditional environmental influences involving operant contingencies, taste aversion, schedule induced behavior, and classical conditioning, as well as, the less often considered variables, at least in our discipline, inherent within the biology of the organism. To thoroughly investigate the major social issue of predisposition to drug abuse, all sources of potential controlling variables must be considered.

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